

NCERT Exemplar Solutions of Class 11 Biology – Chapter 16: Digestion and Absorption

LONG ANSWER TYPE QUESTIONS

1. A person had roti and dal for lunch. Trace the changes during passage through the alimentary canal.

Solution:

Enhanced Step-by-Step Digestion:

1. Buccal Cavity:

- **Mechanical:** Chewing breaks food into smaller pieces
- **Chemical:** Salivary amylase converts starch (roti) to maltose
- **Lubrication:** Saliva moistens food for swallowing
- **Formation:** Food becomes bolus

2. Esophagus:

- **Peristaltic movements** transport bolus to stomach
- **No digestion** occurs here

3. Stomach:

- **Physical:** Churning mixes food with gastric juice → forms chyme
- **Chemical:**
 - HCl activates pepsinogen → pepsin
 - Pepsin breaks proteins (dal) → peptones and proteoses
 - Gastric lipase acts on lipids (minimal)
- **pH:** Becomes highly acidic (1.5-2.0)

4. Small Intestine (Duodenum):

- **Pancreatic juice** (alkaline, pH 8.5) contains:
 - Pancreatic amylase: Starch → maltose, isomaltose
 - Trypsin, chymotrypsin: Proteins → peptides
 - Pancreatic lipase: Fats → fatty acids + glycerol
- **Bile:** Emulsifies fats for better enzyme action
- **Intestinal juice:** Completes digestion

5. Small Intestine (Jejunum & Ileum):

- **Final digestion:**
 - Maltase: Maltose → glucose + glucose
 - Peptidases: Peptides → amino acids
 - Lipases: Complete fat digestion
- **Absorption:** Through villi and microvilli

6. Large Intestine:

- **Water absorption**
- **Electrolyte absorption**
- **Formation of feces**

2. What are the various enzymatic secretions in our gut? What is the nature of end products after complete digestion?

Solution:

Enhanced Classification of Digestive Enzymes:

A. Gastric Secretions:

- **Pepsin:** Proteins → peptones + proteoses
- **Gastric lipase:** Triglycerides → diglycerides + fatty acids
- **Rennin (infants):** Casein coagulation

B. Pancreatic Secretions:

- **Proteolytic:** Trypsin, chymotrypsin, carboxypeptidase
- **Carbohydrate-digesting:** Pancreatic amylase
- **Lipid-digesting:** Pancreatic lipase, phospholipase
- **Nucleic acid-digesting:** Ribonuclease, deoxyribonuclease

C. Intestinal Secretions:

- **Disaccharidases:** Maltase, lactase, sucrase
- **Peptidases:** Aminopeptidase, dipeptidase, tripeptidase
- **Nucleotidases and nucleosidases**

Final End Products:

Macromolecule	End Products	Enzymes Involved
Carbohydrates	Glucose, fructose, galactose	Amylases, disaccharidases
Proteins	Amino acids	Proteases, peptidases
Lipids	Fatty acids + glycerol	Lipases
Nucleic acids	Nitrogenous bases + pentose sugars + phosphates	Nucleases, nucleotidases, nucleosidases

3. Discuss mechanisms of absorption.

Solution:

Enhanced Absorption Mechanisms:

1. Simple Diffusion:

- **Process:** Movement along concentration gradient
- **Substances:** Water, small molecules, gases
- **Energy:** No energy required
- **Example:** Water absorption in colon

2. Facilitated Diffusion:

- **Process:** Carrier-mediated transport
- **Substances:** Glucose, amino acids (some)
- **Energy:** No energy required
- **Example:** Glucose absorption via GLUT transporters

3. Active Transport:

- **Process:** Against concentration gradient
- **Energy:** ATP required
- **Types:**

- **Primary:** Direct ATP use (Na⁺-K⁺ pump)
- **Secondary:** Uses Na⁺ gradient (SGLT1 for glucose)

4. Osmosis:

- **Process:** Water movement across semipermeable membrane
- **Driving force:** Osmotic gradient
- **Location:** Throughout GI tract

5. Pinocytosis:

- **Process:** Cellular drinking
- **Substances:** Large molecules, proteins
- **Example:** Absorption of antibodies in newborns

Specific Examples:

- **Carbohydrates:** Secondary active transport (SGLT1)
- **Amino acids:** Multiple transport systems
- **Lipids:** Form micelles → simple diffusion
- **Vitamins:** B₁₂ requires intrinsic factor
- **Minerals:** Various specific transport proteins

4. Discuss the role of hepatopancreatic complex in digestion.

Solution:

Enhanced Role of Hepatopancreatic Complex:

A. Liver Functions:

1. Bile Production:

- **Composition:** Bile salts, phospholipids, cholesterol, bilirubin
- **Function:**
 - Emulsification of fats
 - Provides alkaline medium (pH 7.5-8.5)
 - Facilitates lipase action

2. Metabolic Functions:

- **Carbohydrate metabolism:** Glycogen storage
- **Protein metabolism:** Urea formation, plasma protein synthesis
- **Lipid metabolism:** Cholesterol synthesis

B. Pancreatic Functions:

1. Exocrine Secretions:

- **Bicarbonates:** Neutralize acidic chyme
- **Enzymes:** Complete digestion of all macromolecules

2. Specific Enzyme Actions:

Nutrient	Enzyme	Action
Carbohydrates	Pancreatic amylase	Starch → maltose, isomaltose
Proteins	Trypsin, chymotrypsin	Proteins → peptides
	Carboxypeptidase	Removes C-terminal amino acids

Nutrient	Enzyme	Action
Lipids	Pancreatic lipase	Triglycerides → fatty acids + glycerol
	Phospholipase	Phospholipids → lysophospholipids
Nucleic acids	Nucleases	DNA/RNA → nucleotides

C. Coordinated Function:

1. **Bile** prepares fats for enzymatic digestion
2. **Pancreatic bicarbonates** create optimal pH
3. **Pancreatic enzymes** complete chemical digestion
4. **Integration** ensures efficient digestion of all nutrients

5. Explain the process of digestion in the buccal cavity with a note on the arrangement of teeth.**Solution:****Enhanced Buccal Cavity Digestion:****A. Functions of Buccal Cavity:****1. Mechanical Digestion:**

- **Mastication:** Teeth break food into smaller pieces
- **Mixing:** Tongue mixes food with saliva
- **Bolus formation:** Prepares food for swallowing

2. Chemical Digestion:

- **Salivary amylase:** Converts starch → maltose (30% of starch digested)
- **Optimal conditions:** pH 6.8, temperature 37°C
- **Limited action:** Due to brief contact time

3. Other Functions:

- **Lubrication:** Mucin in saliva
- **Antimicrobial action:** Lysozyme in saliva
- **Taste perception:** Taste buds

B. Arrangement of Teeth:**1. Types of Teeth:**

- **Incisors (I):** Cutting and biting
- **Canines (C):** Tearing
- **Premolars (PM):** Grinding and crushing
- **Molars (M):** Grinding and crushing

2. Dental Formula: 2123/2123

- Represents teeth in each quadrant (half of upper/lower jaw)
- **Total teeth:** $(2+1+2+3) \times 4 = 32$ teeth

3. Tooth Structure:

- **Crown:** Visible part covered with enamel
- **Root:** Embedded in jaw, covered with cementum
- **Dentin:** Main tooth material

- **Pulp cavity:** Contains nerves and blood vessels

4. Thecodont Nature:

- Each tooth embedded in separate socket (alveolus)
- Held by periodontal ligaments
- Provides strong anchorage for effective chewing

Integration: The coordinated action of teeth (mechanical breakdown) and salivary enzymes (chemical breakdown) initiates the digestive process, preparing food for efficient digestion in subsequent parts of the alimentary canal.

